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ABSTRACT

The Copernicus Project is a multi-district effort designed to incorporate technology, specifically the laptop computer, into the instructional and learning process of the public schools. Participants included six school districts in Washington state, the Toshiba and Microsoft Corporations, and parents. The project called for a 1 to 1 student-to-laptop computer ratio, with the computers owned or leased by the students and taken home each night. Three student learning outcomes were established as primary project goals: increased proficiency in technical reading, writing, and presenting; increased competency in the use of information access, data collection, analysis, problem solving, and collaborative research skills; and demonstrated ability to use information technology and understand its uses in society and the workplace. The instructional use of computers was nearly evenly divided between teaching computer skills and programs, and teaching academics using the computer as an educational tool. During approximately 35% of the classes observed, students were involved in teacher-directed lessons; during 40% of classes, students were involved in independent work; and in 25% of classes, students were involved in teacher-directed activities, followed by independent work. The most frequently used software application was Microsoft Word, followed by Excel and PowerPoint. Writing skills were the most directly affected by the use of laptops, followed by communication and presentation skills. Overall, teachers, parents, and students are generally positive about the project and see the real or potential value of laptops for learning. Among some teachers and parents there is a degree of dissatisfaction with the project. (SWC)

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Copernicus Project: Learning With Laptops

Year 1 Evaluation Report

August, 1997

Project Evaluators:

Jeffrey T. Fouts
Carol Stuen

School of Education
Seattle Pacific University
Seattle, WA 98119
206-281-2216
jfouts@spu.edu

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Copernicus Project -- Executive Summary

I. DESCRIPTION OF THE PROJECT

The Copernicus Project is a multi-district effort designed to incorporate technology, and specifically the laptop computer, into the instructional and learning process of the public schools. Participants include the Snohomish, Seattle, Federal Way, Peninsula, Pasco, and Freeman School Districts. Similar programs are being implemented concurrently in a number of school districts across the United States. The project calls for a partnership plan between the school districts, the Toshiba and Microsoft Corporations, and parents.

The intent of the program is to bring technology into the classroom to the extent that its use will be incorporated into all appropriate components of the standard curriculum. During Year 1 of the project each of the computers contained Windows 95 and the standard application software of MS Office, including Word, Excel, Power Point, Access, and Explorer.

As originally conceived, the project called for a 1 to 1 student-to-laptop computer ratio for a given classroom, with the computers owned or leased by the students and taken home each night. Additionally, the project called for extended teacher training on the incorporation and use of laptops in the classroom, and parent training and involvement activities.

Goals of the Copernicus Project

Three broad student learning outcomes have been established as the primary project goals.

1. Increased proficiency in technical reading, writing, and presenting to meet the Washington Essential Learnings.
2. Increased competency in the use of technology for information access, data collection, analysis, problem solving, and collaborative research skills as defined in the Washington State Essential Learnings."
3. Demonstrated ability to use information technology and understand its uses in society and the workplace which align with Washington States fourth learning goal.

II. EVALUATION DESIGN

Process questions:

1. In what ways are the teachers using the laptop computers and related technology in the instructional process?
2. In what ways have the instructional, learning, and assessment activities and the curriculum changed because of the technology?

Product questions:

1. How has the technology affected students in the traditional educational outcome areas?
2. What new or additional learning or outcomes have been demonstrated because of the technology?

Evaluation and Data Collection Procedures

The evaluation plan for the Copernicus Project covers a three year period from September, 1996, through August, 1999. The plan focuses on formative evaluation questions during year 1, with the intent of using those results to identify appropriate student learning outcomes for the summative or product evaluation for succeeding years.

The process evaluation questions on instructional usage and changes were answered through an on-going monitoring process of the project classrooms. Interviews and observations were conducted between February and June, 1997. Parent questionnaires and student questionnaires about the program were used in three of the districts.

The primary focus of the evaluation is on the use of the laptop computers and related technology in the instructional process and changes in the curriculum, instructional, learning, and assessment activities in the classroom. The evaluation was designed to provide a broad overview and generalizations for the project, and not as a detailed account of what happened in any given district.

III. EVALUATION RESULTS

Degree of Program Implementation

Finding 1. The computer to student ratio, the date of implementation, and the amount of teacher training differed for each district. The varying degree of program implementation greatly influenced the degree to which the laptop computers and related technology changed the instruction, learning, and assessment activities in the classroom, and the degree to which the curriculum was affected.

Instructional Use of the Laptop Computers and Classroom Changes

Instructional Focus

Finding 2. Results of observations show that instructional use of computers was nearly evenly divided between teaching computer skills and programs, and teaching academics with the computer used as an educational tool. The major exception to this finding was at the immersion high school where computer application skills were taught in a separate course, meaning that content-area teachers focused exclusively on academic content.

Classroom Activities

Finding 3. During approximately 35% of the classes observed, students were involved in lessons directed entirely by the teacher; during 40% of the classes observed students were involved in independent work, either working on assignments given that day, or completing long-term assignments and presentations. In 25% of the classes observed, students were involved in teacher directed activities, which were followed by independent work -- either skill practice or assignment completion.

Software Usage

Finding 4. The most frequently used software application was Word, followed by Excel and PowerPoint . This was true across both immersion and alternative model schools.

Laptops and Learning Outcomes

Finding 5. Teachers frequently mentioned writing skills as the academic outcome they felt was most directly affected by the use of laptops, followed by communication and presentation skills.

Teacher, Parent and Student Attitudes About the Project

Finding 6. Overall, teachers, parents and students, are generally positive about the project and see the real or potential value of laptops for learning.

Finding 7. Among some teachers and parents there is a degree of dissatisfaction with the project, ranging from mild to very strong.

IV. CONCLUSIONS

For elementary and secondary teachers and students the use of the laptops seems particularly suited for writing activities, student projects, presentations, and information storage and retrieval purposes. Data analysis and spread sheet type activities, and information access through the Internet, CD ROM and related technologies certainly have potential, but initial uses of the laptops for these purposes in this project were more limited for a number of reasons.

V. RECOMMENDATIONS

Schools should move toward the immersion model if possible. Evaluation activities during the second year should focus on evaluating the effects of the laptops on writing and presentation skills, and identifying the potential value for specific content area learnings. Teacher training and shared curriculum development activities should be a high priority by all the districts. Administrative and technical support for the project, and increased parental involvement should continue to receive attention in all districts.

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I. DESCRIPTION OF THE PROJECT

The Copernicus Project is a multi-district effort designed to incorporate technology, and specifically the laptop computer, into the instructional and learning process of the public schools. The project is modeled after similar successful programs in Australia, with the goal of having a laptop computer for every student and available to aid and to use as a tool for learning "anytime, anywhere." Similar programs are being implemented concurrently in a number of school districts across the United States. The project calls for a partnership plan between the school districts, the Toshiba and Microsoft Corporations, and parents. Initial plans for the project called for students and their parents to buy or lease laptop computers for student use.

The intent of the program is to bring technology into the classroom to the extent that its use will be incorporated into all appropriate components of the standard curriculum. In this vision, technology is not seen as simply an additional subject, but a tool to be used in all subject areas. It is believed that this technology, when used as intended, will transform the way those subjects are taught and what learning those students are expected to demonstrate. The demonstration of much of this proposed student learning will not be "extra" assignments, but will happen over the course of the year as the attainment of the regular curriculum goals is evaluated. The project involves a variety of grade levels, elementary through secondary, and subject areas, and this means that the usage of the technology will differ from district to district, school to school, and class to class. During Year 1 of the project each of the computers contained Windows 95 and the standard application software of MS Office, including Word, Excel, Power Point, Access, and Explorer. Depending on school resources, some students and classrooms had Internet access, projection systems, and the use of other software programs.

As originally conceived, the project called for a 1 to 1 student-to-laptop computer ratio for a given classroom, with the computers owned or leased by the students and taken home each night. This feature was seen as important because it allowed the students to continue and extend the learning activities beyond the classroom and to involve their parents more fully in the learning process. Additionally, the project called for extended teacher training on the incorporation and use of laptops in the classroom, and parent training and involvement activities.

Participating Districts and Schools

Snohomish School District

Cascade View, Seattle Hill, Dutch Hill, Cathcart, Emerson, Riverview, Machias, and Totem Falls Elementary Schools.

Seattle School District

Meany Middle School

Federal Way School District
Thomas Jefferson High School
Illahee Junior High School

Peninsula School District
Artondale, Discovery, Evergreen, Harbor Heights, Minter Creek, Purdy, Vaughn and Voyager Elementary Schools
Gig Harbor, Henderson Bay, and Peninsula High Schools
Goodman, Key Peninsula, Kopachuck and Harbor Ridge Middle Schools.

Pasco School District
Robert Frost Elementary School

Freeman School District
Freeman High School

Goals of the Copernicus Project

The ultimate purpose of this educational program is to produce a positive affect on students, particularly in the area of student learning. The primary goals focus on the students. Three broad student learning outcomes have been established as the primary project goals.

1. Increased proficiency in technical reading, writing, and presenting to meet the Washington Essential Learnings.
2. Increased competency in the use of technology for information access, data collection, analysis, problem solving, and collaborative research skills as defined in the Washington State Essential Learnings."
3. Demonstrated ability to use information technology and understand its uses in society and the workplace which align with Washington States fourth learning goal.

II. EVALUATION DESIGN

The ultimate goal of the project is to increase student learning. However, to affect an end product, in this case student learning, it is necessary to change or enhance the process by which we hope to obtain the product. While some objective student data can be used in the short term, we must rely heavily, particularly in the first year, on indicators of the changes in the *process* which we believe will lead to greater learning, which is the ultimate goal of the project. Therefore, this evaluation model is built on the assumption that changing teacher and student behaviors, and altering the methods of teaching and learning will lead to greater learning for students. We expect the actual observable changes in student learning to be more fully evident in later years.

Consequently, this plan employs both process (formative) and product (summative) evaluation strategies. The process evaluation is important to insure that the technology is being utilized as intended, and to allow more certitude about the effect of technology on student learning when used in this way. This is particularly important in the first year. The product evaluation is important to determine if the instructional changes result in increased and/or alternate student learning in succeeding years.

The process and product evaluation addresses the following questions.

Process questions:

1. In what ways are the teachers using the laptop computers and related technology in the instructional process? **(Instructional Use)**

2. In what ways have the instructional, learning, and assessment activities and the curriculum changed because of the technology? **(Changes)**

Product questions:

1. How has the technology affected students in the traditional educational outcome areas? **(Traditional Outcomes)**

2. What new or additional learning or outcomes have been demonstrated because of the technology? **(New Outcomes)**

Evaluation and Data Collection Procedures

The evaluation plan for the Copernicus Project covers a three year period from September, 1996, through August, 1999. The plan focuses on formative evaluation questions during year 1, with the intent of using those results to identify appropriate student learning outcomes for the summative or product evaluation for succeeding years.

The process evaluation questions on instructional usage and changes were answered through an on-going monitoring process of the project classrooms. Seven teachers were selected from each of the five of the participating districts, for pre-and post-implementation interviews. The classrooms of these teachers were observed on multiple occasions. In addition to the observations, occasional informal student interviews were conducted and student work and curriculum content were examined. These interviews and observations were conducted between February and June, 1997. Parent questionnaires and student questionnaires about the program were used in three of the districts. In the sixth district data collection was not planned because of the delayed implementation of the project.

Observations were carried out from February to June of the 1996-97 school year. While it was anticipated that the observations might begin earlier in the year, the actual arrival and set-up of laptop materials took much longer than expected, and delayed the start of observations, in some cases up to several months. Observations lasted anywhere from 20 - 60 minutes, and were generally scheduled a day or more in advance. However, the lack of consistency in implementation of the program made scheduling extremely difficult. In addition to making observation notes on the instructional and student use of computers, both students and teachers were asked to provide feedback about their perceptions of the program in general, as well as their perceptions about specific assignments and applications.

This evaluation does not focus on the quality of the implementation or why certain developments happened in a given district. The *primary focus* of the evaluation is on the use of the laptop computers and related technology in the instructional process and changes in the curriculum, instructional, learning, and assessment activities in the classroom. The evaluation was designed to provide a broad overview and generalizations for the project, and not as a detailed account of what happened in any given district. While the conclusions of this first year of the evaluation may hold true for a specific district, a local outcome may have been quite different.

III. EVALUATION RESULTS

Degree of Program Implementation

Finding 1. The computer to student ratio, the date of implementation, and the amount of teacher training differed for each district. The varying degree of program implementation greatly influenced the degree to which the laptop computers and related technology changed the instruction, learning, and assessment activities in the classroom, and the degree to which the curriculum was affected.

The computer to student ratio, the date of implementation, and the amount of teacher training differed for each district. Consequently, these factors greatly influenced the degree to which the program was implemented as conceived. As would be expected, this varying degree of program implementation greatly influenced the degree to which the laptop computers and related technology changed the instruction, learning, and assessment activities in the classroom, and the degree to which the curriculum was affected.

During the 1996-97 school year Rockman & Associates, an educational consulting firm in San Francisco, conducted an evaluation of the national participants in the Toshiba/Microsoft laptop computer programs. In these 53 public and private schools throughout the United States, each began with the original project model which called for a 1 to 1 student-to-laptop computer ratio for a given classroom, and with the computers owned or leased by the students and taken home each night. However, during the evaluation process of the first year of these programs, Rockman & Associates concluded that only a few of the districts had implemented the programs as originally designed. From their research they were able to categorize the types of implementation into five groupings.

1. Concentrated/immersion model – Generally, 1 student, 1 laptop computer. Every child (or close) in the class has a laptop computer. Many are owned or leased by the students. The computers may be taken home. Schools and districts in this model are reasonably close to implementing the program as originally conceived.

2. Dispersed model – Schools have purchased the laptops and they are dispersed among a number of grades or classes. There is not a 1 to 1 student to computer ratio. More typically, there are 5 to 10 laptops in a classroom. Generally, they remain owned by the school and may not be taken home, although some students may own their own.

3. Class set model – Schools have purchased the laptops and the computers are kept in sets of about 20 to 30 computers. The set is mobile, shared by two or more teachers and moved from

class to class. They are used by a teacher for a set block of time, such as two weeks, or may be used one or two days a week. Ownership is maintained by the school and they may not be taken home.

4. Desktop model --. Either desk top models or laptops are purchased by the school. Whether laptops or desktops, the computers are concentrated in a lab setting. Teachers and students have access to the computers on a scheduled basis, similar to the traditional computer lab arrangements. The computers are owned by the school and may not be taken home

5. Mixed model – A combination of one or more of the preceding models are being used, sometimes concurrently, and sometimes schools have moved from one model to another over the course of the school year.

According to Rockman and Associates, most of the schools claim that these are transition situations and that their goal is to move to the concentrated/immersion model. Factors cited by the schools as influencing the model being used include:

- Schools are in different stages of computer implementation.
- Financing and equity concerns.
- Parental interest and support.
- Volunteer teachers as leaders.
- Degree of top-down/administrative support for the concentrated/immersion model.

The five models identified by Rockman from the national participants in the laptop projects are also an accurate reflection of how the Copernicus Project has been implemented in the State of Washington. The concentrated/immersion model was implemented in eight elementary classrooms in the Snohomish School District and at Thomas Jefferson High School in the Federal Way District. The other five models were implemented in this state at some point during the during the 1996-1997 school year.

Although initial plans called for the project to begin in four of the school districts in the early part of 1996-1997 academic year, only at Thomas Jefferson High School in the Federal Way District did students have computers before Christmas. In the Snohomish, Peninsula, and Seattle School Districts the computers were not available to students until February, March, and April. These delayed starts limited to a considerable degree the impact that the program could have on the classrooms and instruction. In the Pasco School District, the program was implemented only very late in the year and to a very limited degree, with plans to implement on a larger scale beginning in September, 1997. In the Freeman School District, original plans called for program implementation in the 1997-1998 academic year.

Instructional Use of the Laptop Computers and Classroom Changes

Multiple classroom observations and teacher interviews were conducted to determine just how the laptop computers were being used by teachers and students during this first year of program implementation. Documentation of current practice is a necessary first step in the evaluation to answer the process and product questions related to *changes* in student learning. Specifically, the observations and interviews were designed to answer the following process question: "In what ways are the teachers using laptop computers and related technology in the instructional process?"

The observation guide was designed to document both the instructional use of laptop computers by the teacher, and student use of the laptop during the course of the school day. During the interviews conducted at the end of the school year the teachers were asked about the instructional use and value of the laptop computers and related technology based on this year's experience.

Instructional Focus

Finding 2. Results of observations show that instructional use of computers was nearly evenly divided between teaching computer skills and programs, and teaching academics with the computer used as an educational tool. The major exception to this finding was at the immersion high school where computer application skills were taught in a separate course, meaning that content-area teachers focused exclusively on academic content.

In most cases, skill and programmatic instruction involved teaching students specific applications with which they had no prior or only limited experience. These applications included Access, Power Point, Excel, and Netscape. In only two instances were teachers observed giving skill instruction pertaining to Word, and these cases involved direction in such things as paragraph formatting, font selection, and saving and finding documents. According to teachers and students, this is because most students had had previous experience with word processing skills and programs in school computer labs or at home.

An example of skill instruction was the teacher who used figures from a previously completed math assignment involving tallies and percentages in working for the first time with Excel. Students were shown on the TV monitor how to access the Excel application, and then step by step, how to enter the figures into a new Excel document. Direction was given to the class as a whole, with individual students helping each other as needed. It happened during the course of the observation, as it did in many other observations, that questions and problems arose which complicated the planned lesson somewhat. In this case, one girl's screen appeared to be broken, or in some way did not function, so she moved to the teacher's desktop computer to

complete the remainder of the lesson. In addition, students were constantly passing on tips to each other that were not part of the intended lesson, but which increased technological awareness. On this day, one student asked how to spell the word "hypothesis", and another suggested that he "spell the word like it sounds, and then if it gets underlined in red, use the spellcheck to find the correct spelling." Instances like these seemed to occur continually during the course of any given lesson.

In most cases when instruction was academic in nature, Word was the application used. For example, in one classroom students were asked to use a Word document to record results of a brainstorming session to identify 5 important rules for cooperative group work. Students were already familiar with the word processing application, and used it as a tool to complete the assignment. A second example of an academic lesson with the laptop computer used as an educational tool is that of a high school math teacher who introduced the math problem of the day, which involved a new concept (cost comparison equations). This concept was explained using the TV monitor, and then students were required to determine how the equations should be set up, and to then use the laptop computer to translate the information from the equations into a graph showing actual cost comparisons. In this case the Excel application was used.

Classroom Activities

Finding 3. During approximately 35% of the classes observed, students were involved in lessons directed entirely by the teacher; during 40% of the classes observed students were involved in independent work, either working on assignments given that day, or completing long-term assignments and presentations. In 25% of the classes observed, students were involved in teacher directed activities, which were followed by independent work - either skill practice or assignment completion.

Observations of student use of the computer revealed that in approximately 35% of the lessons observed, students were involved in lessons directed entirely by the teacher. This was most common when the lesson involved instruction in a new skill or program, where students followed along as the teacher demonstrated the skill on the TV monitor. For example, one 30 minute observation involved a teacher demonstrating the use of Excel to create a wordfind using the weekly spelling words. As the teacher created a wordfind on the TV monitor, students followed along and created the same document on their own laptops.

Another 40% of the observations indicated that students were involved in independent work, either working on assignments given that day, or completing long-term assignments and presentations. In one classroom observation, students spent time designing gameboards which dealt with information on different countries in Africa. In another case, students used the Word application to type stories they had written which were to go in their year-end portfolios.

In 25% of the observations, students were involved in teacher directed activities, which were followed by independent work--either skill practice or assignment completion. For example, in one sixth grade classroom students spent the first part of the class learning how to create and save a new document. This was followed by independent work where they typed a handwritten draft of a research summary into a Word document and saved it. In another example, a high school teacher began the class session by showing students on the TV monitor how to enter Likert-type data into an Excel spreadsheet, after which the students spent the rest of the time working independently on their research projects.

From the classroom observations and interviews with teachers, different patterns of usage between the immersion model and the alternative implementation models emerged. At the high school using the immersion model, skills and programs were never taught in the laptop classrooms. This kind of instruction was limited to the computer applications class that all of the laptop students were required to take. When laptop students were in their other classes (English, Global Studies, Science, etc.) the sessions were limited to academic work. These teachers did not involve themselves in computer skill instruction. In the elementary immersion classrooms, however, teachers were still involved in some types of skill and program instruction. This was most often with programs and skills other than word processing, such as Excel spreadsheet applications, Power Point applications, and improvement of keyboarding skills. Very seldom was instruction related to Word. Teachers in these elementary immersion classrooms did report that time allocated to teaching application skills lessened considerably as the year progressed, providing more time for academic instruction and activities.

In alternative model schools, however, skill and program instruction was necessary in basic computer skills and in the less familiar applications such as Excel, Power Point and Access. While they were also involved in academic instruction, this often was preceded by some type of skill instruction.

It appears, then, that the addition of a separate computer applications class lessened the need for classroom teachers to involve themselves in the teaching of computer skills and programs. They were able to work on the assumption that necessary skills were being developed in another setting, and to assign projects knowing that the students had the knowledge and abilities to carry out those projects. In alternative model schools, however, and even in the immersion elementary schools, teachers needed to spend a significant amount of time teaching programs and skills *before* they could move on to academic applications.

In nine of the observations, the teacher had some sort of assistance in the classroom, where a parent or aide moved throughout the room assisting students. It was clear in many cases that the teachers could use additional help during computer time, particularly during program and skills instruction. Some students would catch on relatively quickly, and be ready to move ahead, while others had problems that would completely stop them and require the assistance of the teacher before they could proceed. In addition, there were the technological problems that

needed attention by the teacher (when possible). These included loss of battery power, difficulty accessing applications, broken screens, and the like. Despite the best planning by teachers, there were almost always small problems that occurred throughout the course of any lesson which necessitated the teacher stopping the lesson and helping individual students.

Software Usage

Finding 4. The most frequently used software application was Word, followed by Excel and PowerPoint . This was true across both immersion and alternative model schools.

According to data gathered through the observations and interviews, the most frequently used application was Word. This was true across both immersion and alternative model schools. Types of assignments done with the Word applications included taking notes during a class lecture; preparing social studies reports and science experiment write-ups; and writing poems, stories, and journal entries.

The second most often-used application was Excel. This application was used to create spreadsheets for data entry, and to design graphs which would appropriately display this data. Excel was used at the elementary, middle, and high school levels, but involved skill instruction by elementary and middle school teachers. Power Point was third most used application. Typical uses for the elementary teachers and students was for presenting book reports and social studies reports, while in the middle school and high school it was used for science and global studies presentations.

Access and Netscape were used least often. Elementary teachers had their students use Access to keep learning logs, which documented work assigned and completed. Netscape (Internet connection) was only available in two of the participating schools, and even in those it was later in the year that access to the Internet was available. In those classrooms where it was observed being used, students were able to do a variety of searches to gather information for reports and presentations. At the immersion high school, for example, students were give a number of Internet addresses related to the future of Japan, and spent their time accessing those sites and gathering information to answer questions necessary to complete a global studies project.

Laptops and Learning Outcomes

Finding 5. Teachers frequently mentioned writing skills as the academic outcome they felt was most directly affected by the use of laptops, followed by communication and presentation skills.

During end of the year interviews, teachers were asked about what learning benefits they saw from using the laptops in the classrooms. Not unexpectedly, their responses generally reflected the nature of the application software in the MS Office program. Teachers frequently mentioned writing skills as the academic outcome they felt was most directly affected by the use of laptops, which corresponds to the usage of Word, the word processing program used most frequently in most of the classes. Communication and presentation skills were also mentioned by many teachers as being greatly enhanced.

During pre- or early implementation stages of the project, all teachers selected for interviews were asked about their intended uses of the laptop computers and the school curriculum. Virtually all teachers indicated that they did not see the computer altering the existing curriculum, but rather saw it as a tool to enhance the teaching of the existing curriculum and educational goals. During end of the year interviews, all had confirmed that this was indeed how they had been used, but for some teachers, their instructional approach had changed in that they had required or relied more on the use of student projects than previously, particularly in the immersion classrooms. They also reported that student cooperative learning and students assisting/teaching each other had increased. A number of teachers felt that the products produced by the students were better than any before that their students had produced, and that this type of learning was more in line with the new state essential learnings and exhibitions of mastery. But most of these teachers also indicated that evaluating these products involved a degree of subjectivity that was problematic in determining the value of the laptops in the learning process.

While a number of teachers felt that student projects and the resulting products were in some ways relatively sophisticated, there was not agreement among the teachers as to the degree to which that represented increased understanding of a particular subject matter. This uncertainty was found across the implementation models, but was more common where a non-immersion model was being used. As one teacher put it: "*The program as it exists now probably is not increasing learning in the content areas.*" However, another teacher in the same type of setting felt that the products of her slow learners "*not only look good*" but "*they seem to understand it.*"

Teachers differed on their views about the extent to which the teaching of computers skills detracted from the time available for content coverage. In the immersion high school where the computer skills and software applications were taught in a separate course, it was not a problem. However, some of the teachers in the elementary immersion classrooms did believe that they did

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have to spend a considerable amount of time teaching computer skills at the expense of the regular curriculum, at least initially. But many of these teachers said they were able to catch up once the computer basics had been taught, and even move faster. Several teachers saw this as a minor problem during the first year, but as students continued in the program in future years, there would be less and less need for such instruction.

Several teachers did believe that under certain conditions, the potential exists for increased content learning because of laptops. First, classroom access to the Internet and other technologies such as CD ROMs , which many of the teachers did not have during this first year, can provide considerable information for students not currently available, and thus increase content learning. Second, enhanced curriculum planning that incorporates the power of the computer and application software into instruction may also enhance content learning. Third, with extensive teacher training, teachers may become more skillful in how to use the power of the computer to teach content.

Other positive educational outcomes mentioned frequently by teachers included the exceptional student growth in technology and computer skills. Coupled with this was a very positive attitude toward technology and a growing self confidence and comfort with its use to the point where it almost became "*second nature*."

Related to learning, several teachers believed that the greatest beneficiaries of use of the laptops were disadvantaged, handicapped, or struggling learners. One teacher referred to the laptop as *"a great equalizer."* Another said that with the laptop, *"the kid who struggles with the material is more likely to keep trying."* However, an immersion teacher pointed out that the computer is no panacea, and that while some low achievers have benefited, others are still struggling. He recommended, *"Do not do it because you think it will solve all the educational problems. Do it to give them a whole set of new skills for the future."*

Teacher, Parent and Student Attitudes About the Project

Although this evaluation did not focus specifically on the quality or the efficacy of the implementation efforts, it is important to note that *how well* the program was implemented and managed did impact the results of the evaluation. In addition to the varying models employed in the districts, degree or quality of program implementation differed. Generally, teacher and parent perceptions about the project were positive. However, throughout the project, and even within a given district or school, teachers perceptions about how well the project was implemented and managed did differ greatly. This is reflected by one parent who had two children participating in the project, but at different schools.

> *[At one school] It was a huge disappointment and what we felt was a waste of money the district spent on those laptops. Conversely our child at [the second school] had a wonderful experience on the laptops and gained much information.*

General findings about the attitudes toward the project are listed below.

Finding 6. Overall, teachers, parents and students, are generally positive about the project and see the real or potential value of laptops for learning.

For the most part, teachers indicated that they believe this is an important project and education must go in this direction. Many teachers were tired at the end of the year, and some indicated that this was the most tiring or frustrating year of their career, yet also the most exciting. Many teachers commented that they see the potential of the computer, but still recognized that there was much learning and work yet to be done. Typical teacher comments about their year included:

Wow, has this been the year!

It was a good year, but a challenging year.

When I am teaching with laptops, I am teaching the way I really want to teach.

Awesome!

Other teachers, while considerably less enthused, were cautiously optimistic. Many teachers see what *could* be done with the computers, but realize that getting there will take a lot more time and effort than they have had to put into the project to this point. Most of the teachers want to continue next year in the project, but a few have reservations about doing so unless certain conditions are met.

Students in both the elementary and high school concentrated/immersion classrooms expressed a high degree of satisfaction with their participation in the project. Results of the student questionnaire showed that 86% of the students responding were pleased with the laptop program, compared to only 8% who responded negatively. Correspondingly, 87% would recommend the program to others, compared to only 6% who would not recommend the program.

Parents of students in these classes were also generally positive. Results of the parent questionnaire showed that 87% of the parents responding were pleased with the laptop program as compared to only 5% who responded negatively. Correspondingly, 89% would recommend the program to others, compared to only 4% who would not recommend the program.

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	Percentage of students responding*		
	positively	negatively	undecided
I like school better this year because of the laptop computer program.	80%	10%	10%
Having a laptop computer has helped me learn more this year.	82%	10%	8%
Overall, I have been pleased with the laptop program this year.	86%	8%	6%
I would recommend participation in the laptop program to other students.	87%	6%	7%

*Note: Elementary students completing questionnaires, n=195, representing approximately 90% of those in elementary immersion classes. High School students completing questionnaires, n=42, representing approximately 80% of those in high school immersion classes. Table figures are combined responses.

	Percentage of parents responding*		
	positively	negatively	undecided
My child seems to have a positive attitude about his/her school experience this year.	87%	8%	5%
Participation in the laptop program has been beneficial to my child.	95%	2%	3%
My child has demonstrated increased interest in school this year.	75%	15%	10%
Overall, I have been pleased with the laptop program this year.	87%	5%	8%
I would recommend participation in the laptop program to others in the District.	89%	4%	6%
If I had it to do over again, I would want my child in the laptop program.	89%	4%	6%

*Note: Elementary students' parents completing questionnaires, n=145, representing approximately 70% of those parents with students in elementary immersion classes. High School students' parents completing questionnaires, n=31, representing approximately 60% of those parents with students in high school immersion classes. Table figures are combined responses.

A very small percentage (n=37) of parents in a district using the non-immersion models also completed the parent questionnaire. Parents of students in these classes were also generally positive, but somewhat less so than were parents whose students were in the immersion model.

Results of those parent questionnaire showed that 73% of the parents responding were pleased with the laptop program, with 21% responding negatively; 75% would recommend the program to others, with 9% who would not recommend the program and 17% undecided. Other responses of these parents were similar to the immersion model parents.

The overall positive attitudes of the parents are reflected in the following selection of comments which came from the three districts which distributed parent questionnaires, and from parents in all the various models of implementation.

Great what the kids are doing. Can't wait for grandchildren to participate.

The classes at [the school] given to the families who purchased laptops were very valuable. I wish every teacher, student and parent had the opportunity to participate in these classes.

This was a first year start-up, a good beginning.

I have had the advantage of working in the classroom and seeing the work they are doing on their laptops. It is very impressive. It would be great if other parents had the same opportunity.

I think it's very exciting to be pioneers in computer education. It makes these children proud of what they are doing and almost amazed at their own capabilities. This has truly been a wonderful year for my child. She is eager to go to school and has frequently performed over and above what is expected of her because learning is fun.

For our child, the laptop program along with after school tutoring has proved to be his most enjoyable school year yet!

These several months with the laptop computer has been new and exciting and beneficial for my children.

[Student] has amazed us with the use of the laptop. He enjoys using it and creates spectacular work. It's great to see [school] teaching such important skills at such an early age.

[The teacher] has made it a wonderful experience for all of the students. Our daughter has learned more than we even expected!

Best tool to encourage school work that I have ever seen!

It was an incredible year, watching my child learn at "light speed," the new technology that was made available to him. I am so thankful he had an opportunity to get a jump start in the technology which will most certainly be part of his working world. I can't say enough positive things to express my pleasure with this program!

Our son has benefited greatly. Keep up the good work. Thank you.

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I believe this has been a very positive experience and am very pleased my daughter has had this chance to increase her computer skills. I would recommend this to other parents.

I think the laptop program is great and I welcome all opportunities to use this learning tool.

I was impressed how my daughter learned how to find her way around in the new programs—she taught me a few things as well.

I endorse this program!

Congratulations on your laptop project! I look forward to next year.

I am extremely impressed with the program—the sense of community in the core groups—as well as student/parent/faculty involvements.

The experience has been a good one.

Finding 7. Among some teachers and parents there is a degree of dissatisfaction with the project, ranging from mild to very strong.

This dissatisfaction stems from several causes across and within the districts, and many of these problems are related. The problems most often cited by teachers and parents with the project are listed below, along with a selection of parent comments reflecting these feelings from the three districts using the questionnaire.

- The project as implemented in the district was not as originally described to the teachers and parents, and the one in which they agreed to participate. This sentiment was expressed in two districts in particular where the teachers and parents believed that they were going to participate in a program of 1 to 1 computer to student ratio (immersion model) and extensive use in the classroom. Consequently, they were less enthused about the program, and in a few cases somewhat negative or skeptical. As one teacher put it: *"What we got is not what I had agreed to participate in."* Another teacher felt that for a variety of reasons, "*the program never really even got off the ground.*" Related parent comments:

  Aside from learning basic operating procedures for Window and Microsoft Office, I did not see a great benefit in my 6th grader using the laptop. . . . Paper and pencil would have done the same job.

  Normal learning activities have not changed from last year. Laptop related learning activities are a lot less than we were told they would be. . . .I hope that

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next year more curriculum items will be geared toward more laptop use, especially for written reports and research in CD reference materials.

I'm excited about the potential for the laptop program, but this year neither of our kids used the computer at school (or was invited to do so) one time.

It seems to many with whom I have spoken that we were sold a system, (with a hefty price tag) with promises of "wonderful things" and now find that its main use will be administrative mail, when and if the file servers are actually in service.

In the time since the laptop program started [student's class] has only had the laptops twice, for 2 weeks total time. He was the only child with his own laptop in his class. I really had hoped they would have more use time than this . . .

We were disappointed with the amount the laptops were used.

- "Promises" made by the district regarding the project were not kept. Some teachers and parents feel they had been led to believe that there would be much more teacher training, parent participation, and technical support than was actually provided. Additionally, some teachers felt that more resources had been promised, such as Internet access, projectors, printers, and additional software. One teacher complained that she had not even had printer paper in months. Another teacher said, "*Maybe if I had been trained on how to use it better, it would be different.*" As it is, he is very ambivalent about participating next year. Related parent comments:

  You asked for, and got a lot of support from a lot of people, to kick off the program. Then you got a lot of tech-friendlies to ante up and put their money in your program. . . . and then nothing happened. Your program has little to offer families who already have computers, at least as it was at [school]. In summation, this program makes a very poor showing on "Bang for the Buck" scale.

  . . . access to the internet from home would have helped in completing their assignment. They were promised this and it didn't happen.

  Still waiting for MS Office '97 upgrade promised 9 months ago.

  This program is a bust! . . . Money and time invested did not achieve proportional results.

  When the student and parent classes did start, they flat out stunk.

  *In closing I would like to state, **I still believe the idea and concept is very good.** I just do not believe it was incorporated into the district and used properly.*

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- The long time delays in program implementation and computer availability led to frustration and lack of enthusiasm for many teachers and parents. Related parent comments:

  The program would have been much more valuable if it had started at the beginning of the school year instead of half-way through it.

  We lost half the year promised.

  Repeated delays in the program did not give the teachers and students adequate time to learn how to operate and develop strategies to utilize in their daily schoolwork.

- There was a perceived lack of planning for the financial aspects and administrative and technical needs of the project. There was also a perceived lack of building level administrative understanding and support in some schools. A number of teachers commented that the lack of technical support was a low point in the program for them, and that these needs could not be overestimated. One teacher said she could never recommend the program to other teachers unless the building principal was knowledgeable and supportive of the idea, which she felt was not the case at her school. A couple of teachers questioned the district's overall commitment to the idea given the way it was implemented. Related parent comments:

  I think the program could be a great thing but a lot of bugs need to be worked out.

  I'm concerned about the apparent lack of planning.

  They definitely need more classroom support and more reliable hardware/software.

  Overall, I believe the laptop program was implemented premature to having the program fully functional . . .

  We have experienced a lot of frustration with the program due to disorganization both by the program . . . and the teacher. . . . We have questioned staying in the program next year.

  I feel the laptop program is great in theory, but that there are bugs that can be worked out to improve the program greatly.

  This was ridiculous to start this program and be so unorganized.

  I thought there was going to be more support because it was a "special" program."

  Seems like a disjointed effort so far.

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IV. CONCLUSIONS

For elementary and secondary teachers and students the use of the laptops seems particularly suited for writing activities, student projects, presentations, and information storage and retrieval purposes. Data analysis and spread sheet type activities, and information access through the Internet, CD ROM and related technologies certainly have potential, but initial uses of the laptops for these purposes in this project were more limited for a number of reasons.

The Copernicus Project has been implemented as conceived in some schools and districts, and with varying degrees of modification in others. The evaluation questions were designed to determine the affect of access and use of laptop computers "anytime, anywhere," with a 1-to-1 student-to-laptop ratio, and with the computer owned or leased by the student to be taken home each night. The majority of what has been learned about the affects of such an educational approach has been drawn from those locations where the model was implemented as originally conceived.

A second implementation factor affecting the evaluation outcomes is the lateness in the academic year at which time the project actually got underway in a given district. The original intent was for the laptop computers to be available and used by the students soon after school started. In fact, the dates of actual first-time computer use ranged all the way from November to April, meaning considerably different lengths of treatment. Thus, even in the immersion classrooms, the degree and/or effectiveness of how the laptops were used may have been quite different if they would have been available several months earlier.

Nonetheless, classroom observations and teacher interviews did reveal certain patterns of usage that are instructive. In the immersion classrooms particularly, teachers and students report and observations confirm that both elementary and secondary teachers and students are quite capable of adapting and using the laptop computer and related technologies in constructive ways. The use of the laptops seems particularly suited for writing activities, student projects, presentations, and information storage and retrieval purposes. Data analysis and spread sheet type activities, and information access through the Internet, CD ROM and related technologies certainly have potential, but initial uses of the laptops for these purposes in this project were more limited. However, as teachers gain confidence, knowledge and experience with this technology, these uses may prove to be of equal or greater importance.

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Additional Considerations

The stated goals of the Copernicus Project place a primary emphasis on increased student learning in a variety of areas, and the underlying assumption of the Project is that the availability and use of the computer will alter classroom instruction and positively affect student learning. However, through the evaluation process a series of important related conclusions about the future of the project have become obvious. *If* computers have the potential for being valuable tools for student learning, computer availability *alone* will not change teacher behaviors in the classroom, enhance the curriculum, or lead students to greater learning.

In many regards this is an experimental program in which teachers were asked to take a general idea and to "run with it." Teachers were asked to incorporate the power of laptop computers and software into their instructional planning, at times with very little training on how that could or should be done. In the initial year of this project the participating teachers were, for the most part, volunteers and those most excited about the use of technology. As a result, they often put in exceptional amounts of time and effort to assure the success of what they were doing. As the project expands in the next several years, undoubtedly, more reluctant teachers and teachers less dedicated to the idea of the project will be expected to participate.

It is important to consider these evaluation results, including the varying degrees of implementation, teacher, student, and parent enthusiasm, and teacher and parent frustrations with the program in some cases, in the larger context of school change and restructuring research. From that research, a number of important findings are emerging and are pertinent to this project.

A study of restructuring efforts in Memphis concluded: "Teachers complained in particular about approaches that required them to rewrite the entire curriculum or create instructional materials themselves." Similarly, John A. Nunnery, an associate research scientist at Johns Hopkins University in Baltimore has concluded: "It is unfair and unrealistic to expect America's overburdened teachers to reinvent their roles and redesign their organizations without providing explicit and proven means of doing so. . . . Reform strategies that work are curriculum-based, have extensive and ongoing professional development that helps teachers deal with classroom instruction, and have clear goals that are well-matched to school goals."

There are a considerable number of researchers who question the usefulness of reforms that fail to provide teachers with the nuts and bolts. Their research has shown that reforms work best when they include explicit teaching techniques, curriculum materials, and instructional tools. For example, in the Memphis study of restructuring, the researchers found that there was a wide variety in how faithfully the schools were to the reform's designs. The greatest variety in quality was found among those programs that provided broad principles but "expected teachers to fill in most of the details. Designs that required teachers to rewrite the curriculum and develop new pedagogy had by far the largest proportion of teachers who reported feeling overwhelmed."

A new study of school reform by the Rand Corporation concluded that schools with the most difficulty in carrying out changes are those that expect teachers to construct their own curriculum and instructional strategies. "They need strong curriculum models, and they need people who can show them how to use those models, and who will be available to do follow-up with them." Eugenia Kemble of the American Federation of Teachers stated: "What teachers really don't want is to reinvent the wheel." Robert Slavin, one of the most respected researchers in education "questions whether many schools have the capacity to create so much innovation from the ground up. He argues that only a handful of schools—perhaps less than 5 percent of elementary or secondary schools in the entire country—have the capacity to translate reform guided by general principles into reality."

Researchers from another national study of school reform concluded : " . . . for genuine instructional changes to take place, teaming must include a common planning period in addition to individual planning time on a daily basis. . . .And without common planning time, even with small teams of students, actual instruction does not appear to change." An additional finding of note: "The first year of implementation includes a fair degree of disruption, and it may take another one or two years for the changes to become institutionalized. Five or more years' experience of institutionalized changes may be required before a cohort of students show maximum differences in behavior."

V. RECOMMENDATIONS

Schools should move toward the immersion model if possible. Evaluation activities during the second year should focus on evaluating the effects of the laptops on writing and presentation skills, and identifying the potential value for specific content area learnings. Teacher training and shared curriculum development activities should be a high priority by all the districts. Administrative and technical support for the project, and increased parental involvement should continue to receive attention in all districts.

1. Those schools which have yet to implement the concentrated/immersion model of a laptop computer for each student should continue to move toward that model if possible. It is with that model that the greatest potential for classroom and learning changes exists. If this level of implementation is not desirable or possible, a clear message should be sent to teachers, students and parents as to what the program in a given location will be. This should help to avoid the frustrations and disappointments that were prevalent in some schools during year 1.

2. Evaluation activities for the second year of the project should focus on the assessment of student learning with the use of the laptop computers. Specifically, as identified by the teachers and confirmed by classroom observations, the student learning outcomes most appropriate for evaluation are writing and presentation skills, as well as others identified by location from the Washington Essential Learnings. Appropriate criteria for the evaluation of student writing and presentation/communication skills need to be developed or identified from existing procedures.

3. In addition to the evaluation of writing and presentation skills, additional evaluation activities during the 1997-1998 year should focus on identifying the value or potential of laptop computers and related technologies for content learning. This is of particular importance as experienced teachers in the project become comfortable with the laptops and as related technologies, such as the Internet, are incorporated in increasing ways into the classrooms. This should allow teachers to expand its uses beyond student writing and presentations, and begin to focus on more of the Washington Essential Learnings.

4. Since the laptops and related technology have most altered the learning activities in those classroom implementing the immersion model, the evaluation activities for student learning outcomes for the 1997-1998 year should be conducted in those classrooms.

5. The need for considerable and in-depth teacher training cannot be over-emphasized, and this should be made a high priority by all districts. This becomes especially important during this second year as new teachers are brought into the program. The training should be as specific and "nuts and bolts" as possible so new teachers do not need to "reinvent the wheel."

6. Project leaders should consider developing common curriculum materials for training students in use of the application software, lesson templates useful in a variety of content areas, and teacher guides for suggested uses of the application software in the content areas.

7. The teaching of the application software in a separate course at Thomas Jefferson High School seemed to be a particularly effective method of teaching these skills to students, thus freeing the classroom teachers to focus exclusively on course content. Where possible, particularly at the secondary level, this model should be seriously considered.

8. Continual efforts should be made to provide and/or upgrade the needed administrative and technical support for the project in those schools where it has been problematic. In addition, parent involvement and education should continue to receive attention in all districts.